

# PROJECT

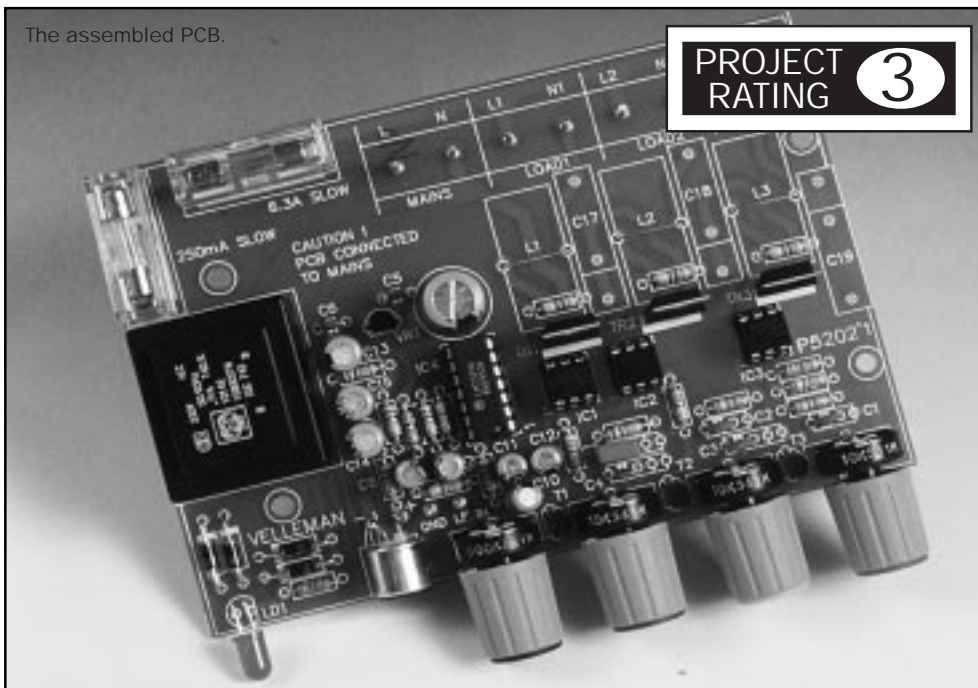
# 3-Channel SOUND-TO- LIGHT UNIT

XZ35Q  
Issue 2

Review by Maurice Hunt

*Add some sparkle to your next party or disco by using this 3-channel Sound-to-Light unit to create dazzling lighting effects that change in time to the rhythm of the background music! The unit features adjustable sensitivity on its 3 channels, that react to the bass, mid-range and treble elements of the music, plus an overall sensitivity (volume) adjustment, so that the lighting effect can be tailored to match any sound level or music type.*

The assembled PCB.



This compact and easy to operate Sound-to-Light unit has three opto-isolated triac-driven outputs, capable of directly driving mains powered lamps of up to 400W per channel. There is a built-in microphone to pick up the background sound, or the unit can be fed an audio input directly, by means of a line-level input. A front panel LED confirms that the unit is powered up.

The project contains almost all the parts needed to produce a working unit, including a high quality PCB and pre-drilled ABS casing, complete with front panel label and knobs with different coloured caps, to create an attractive and professional finished appearance. However, a twin-core mains cable with plug are required to supply power to the unit and mains cable of a suitable current rating will be needed to connect the output sockets to the PCB. Additionally, if interference suppression is required (and this is to be recommended, to avoid the triac switching being heard on nearby AM radio receivers), a toroidal choke and capacitor will be required for each channel (not supplied in kit). Please note that the output sockets supplied are of the American (shaver type) two-pin specification, without earth. However, the casing can be modified to accept the more usual European-standard sockets, which are essential for 230V operation.

## FEATURES

Optically isolated triac driven outputs

Bass, medium, treble and overall sensitivity adjustment

Built in microphone

Line level input

Pre-drilled casing included

Provision for optional interference suppression

Power on LED

## APPLICATIONS

Discos

Parties

Entertainment events

## Circuit Description

Refer to the block and circuit diagrams shown in Figures 1 and 2, respectively. The AC mains voltage is fed through fuse F2 into the step-down transformer, TRANSFO. This brings the voltage down to 9V AC. From here, it passes into the bridge rectifier formed from diodes D1-4, to produce a DC supply. This is smoothed by the large value capacitor C16, and fed into voltage regulator, VR1, to give a steady 8V DC supply to the remainder of the circuit. Low-frequency decoupling of the supply is achieved by C13, while C5 & C6 provide high-frequency decoupling.

Electret microphone insert, MIC, (if fitted) converts the background sound level into a small variable electrical signal, which is boosted by the preamplifier stage, IC4d. Alternatively, if the microphone is omitted, the audio signal can be fed directly into the line level input, in which case, the preamplifier stage is bypassed; the microphone terminals are short-circuited in this case, to prevent spurious signals from being picked up by the preamplifier.

The boosted audio signal passes onto the main amplifier stage, IC4a, whose level of gain is determined by adjusting RV4 – this sets the overall sensitivity of the unit. Note that IC4b & IC4c are unused parts of the LM324 operational amplifier chip; their inputs and outputs are tied to either the positive or negative DC supply rails to prevent spurious interference with the other two op-amp sections.

The output of the main

amplifier is fed via coupling capacitor C12 into each of the three filter networks, formed by R11, C7, C4 & RV1 (bass filter), R12, C2, C3 & RV2 (mid-range filter), and R14, C1 & RV3 (treble filter) that precede the buffer amplifiers (T1-3) for each channel. The preset potentiometers RV1-3 enable the response of each of these three filters to be adjusted independently to suit a range of audio input spectra; for instance,

you might prefer the unit to react more to the higher notes in the music than the lower ones, so you would increase the sensitivity of the treble channel while de-sensitising the bass channel. This enables a more even light pattern to be produced to suit differing types of music, rather than having, say, one light on more often than the other two.

The buffer amplifiers drive the LEDs that sit within the optoisolators, IC1-3. When their

internal LED is lit (which, obviously, cannot be seen), the optoisolators (electrically isolated) outputs pass current to trigger the triacs TR1-3. The isolators are needed to keep the AC mains switched outputs completely separate from the low level DC that the circuit operates at for reasons of electrical safety and to avoid interference/feedback problems.

The triacs switch the mains output to the loads, these

SPECIFICATION	
Operating voltage:	230V AC mains
Triac outputs:	1.75A (400W) at 230V AC
Overload protection:	250mA Time Delay fuse (circuit) 6A Time Delay fuse (output loads)
PCB dimensions:	125 × 88mm
Box dimensions (WHD):	167 × 41 × 140mm

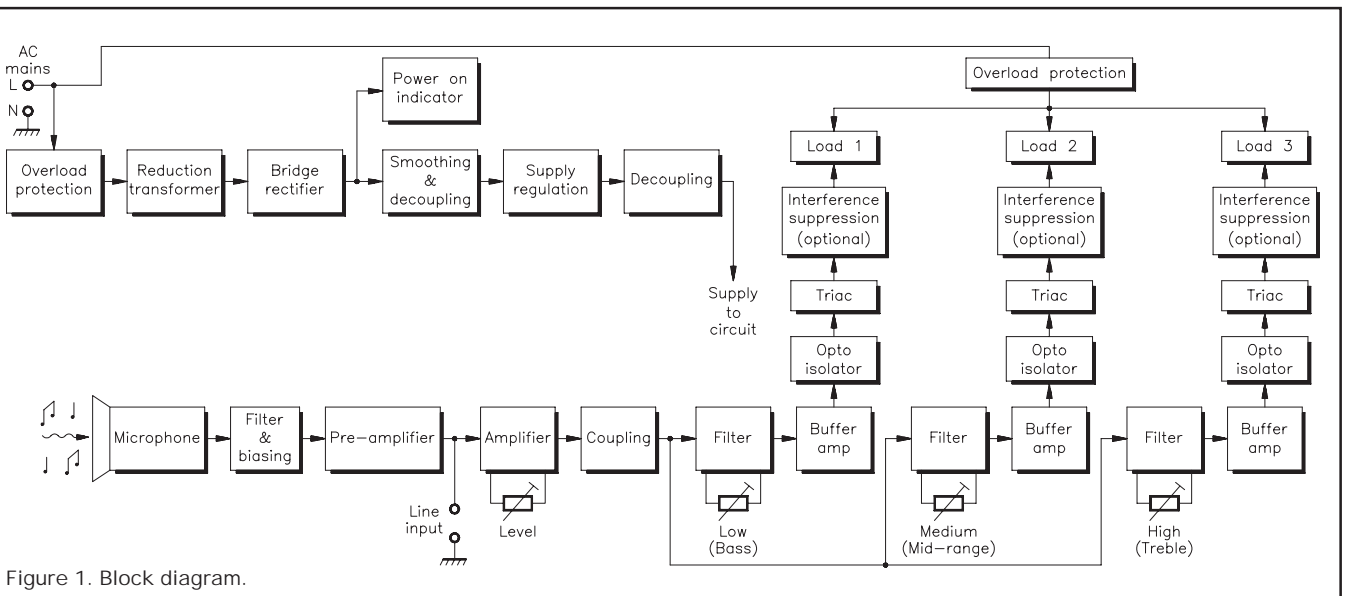


Figure 1. Block diagram.



The completed unit.

usually being mains-rated incandescent lamps. Fuse F1 protects the triacs from excessive current in the event of a short circuit or overload, allowing each channel to pass just over 2A (i.e. a little over 6A total) before blowing. Optional electrical interference suppression may be fitted in

the form of toroidal chokes L1-3, and capacitors C17-19 – there is provision on the PCB to fit these optional components (not supplied in the kit). If, however, you do not wish to fit these components, wire links should be fitted in the L1-3 positions; the space for the capacitors C17-19 is left unused.

## PCB Construction

The kit contains a high quality single-sided fibreglass PCB with printed legend to assist with component placement. The board is constructed in the usual order of ascending component size/height. Commence by fitting the three wire links in the L1 to 3 positions if you are not fitting the (optional) interference suppression capacitors C17 to 19 and chokes L1 to 3. If fitting the suppression components, do not fit the wire links.

Take care to align the DIL holder notches with the legends, and also to correctly orientate the polarised components, i.e., diodes, LED, transistors, voltage regulator, electrolytic capacitors and triacs.

The 12 PCB pins are a tight fit in their holes – heating them with a soldering iron while applying moderate steady pressure will ease them in. If fitting the microphone insert, be sure to connect it to the PCB pins the correct way round; the '-' terminal is that which contacts the metal body of the microphone (there may be two -ve terminals on the microphone). Fit the microphone so that its face sits flush with the edge of the board, but with the body raised so that it sits slightly above the PCB – else it will tend to pick up vibrations through the base of the box. If the microphone is not being used, it must be removed and its connections to the PCB short-circuited.

A length of screened cable (e.g. XR15R) should then be used to connect to the line input (GND and LF IN terminals).



### Important

Apply a thick layer of solder along the length of the already tin-plated (thicker) PCB tracks, to increase their current handling capacity.

The ICs IC1 to 4 should be plugged into their sockets last of all. Having checked your work for misplaced components, solder whiskers, bridges and dry joints, clean excess flux off the board using a suitable solvent.

## Final Assembly

The kit is supplied with a pre-prepared ABS plastic box. The first task is to wipe the front panel clean and apply the label. Next, fit the snap-in spindles into the four potentiometers, rotate the spindle to either end stop, then push the knobs onto the spindles while supporting each potentiometer in turn. Align the notch in the end of the knob with the end stop point of the potentiometer (i.e. at the 5 o'clock or 7 o'clock position, as appropriate). Tighten the knob's central fixing screw, then press a coloured end cap into place (using the colour scheme of your choice!)

The three output sockets supplied are of the American two-pin type, suitable only for use at 110V. As the unit is to be powered from 230V AC

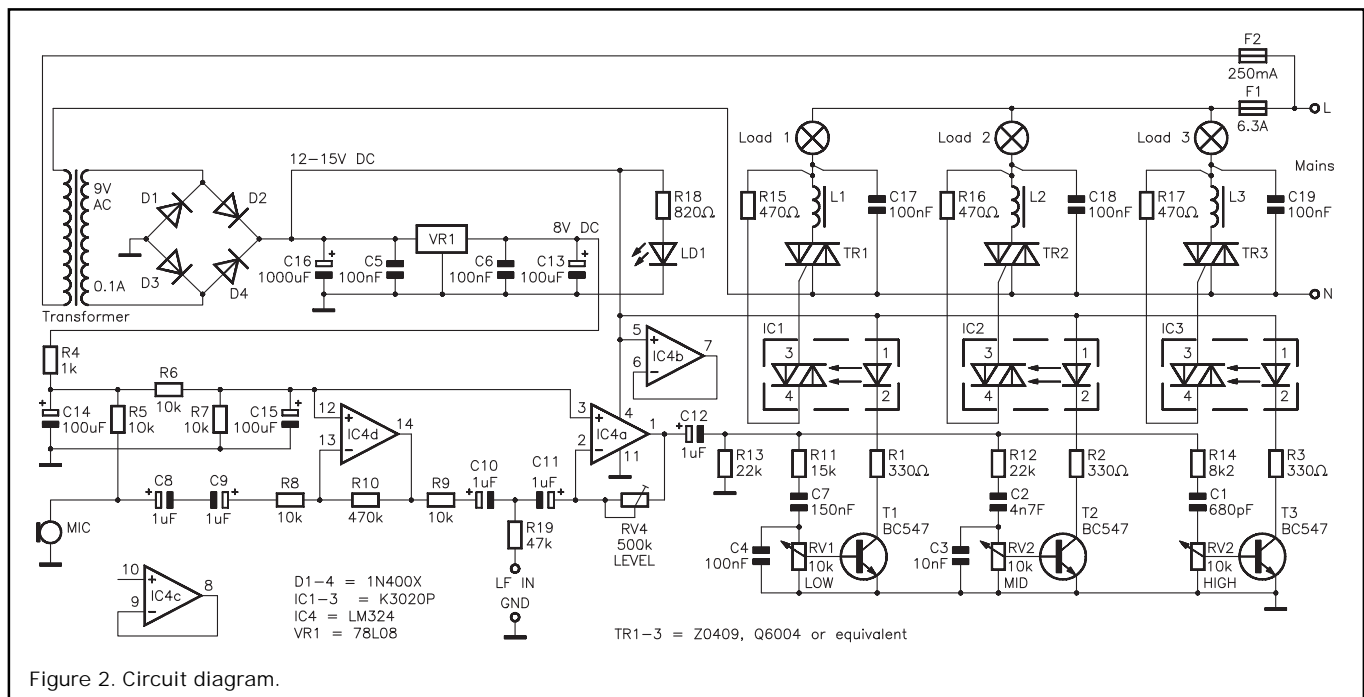


Figure 2. Circuit diagram.

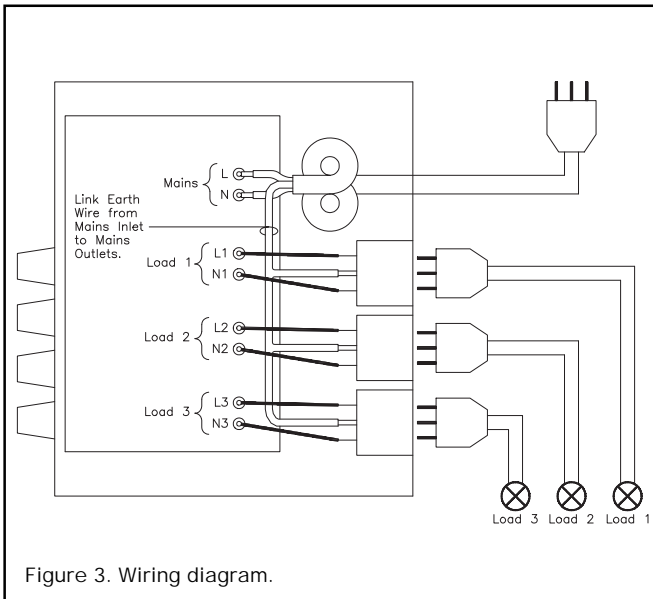


Figure 3. Wiring diagram.

mains, these must be discarded and instead fit an alternate type, rated at 2A 250V AC minimum, such as the plastic 3-pin chassis socket, type SA2404 (Order Code HL48C). This will require a 19mm diameter round mounting hole and is secured by a large nut behind the panel. The pre-cut rectangular holes could be filed out to suit, with any excess being sealed with hard setting epoxy resin or similar. The completed board

can now be fitted into the box, by passing the knobs and LED (and line input cable, if fitted) through the appropriate holes in the front panel, and securing the board in place using the four shakeproof washers and screws supplied.

The board should now be wired up to the outlet sockets and a mains cable as shown in the wiring diagram, Figure 3. Note the method of securing the mains cable, by twisting

it tightly around the two spare posts in the box, in a figure-of-eight. Use a mains-rated cable capable of passing at least 3A (e.g. XR47B) for the wiring to the outlet connectors, and rated at a minimum of 7A (e.g. CW69A) for the mains lead. Attach a 13A plug to the mains lead, fitted with a 7A fuse (Order Code DK19V).

Finally, fit the cover onto the box with the four screws provided.

## Testing and Use

Connect the unit's three outlets up to suitable loads, such as mains powered incandescent lamps of no higher than 400W each. Note that this unit will NOT drive halogen or fluorescent lamps. Plug the unit in to a mains outlet, and switch on. The front panel LED should be lit, and by altering the front panel controls, the load lamps should be switched on and off in response to an audio input, applied either to the built-in microphone (if fitted), or from a tape player output (or similar), via the line level input (if fitted).

By using different settings of the controls, it should be

possible to adjust the lighting pattern to react to different volumes and elements (i.e. bass, mid-range and treble sections) of the audio input being played.

Note that no damage will result if the unit is operated with one or more of the loads disconnected.

Always operate the unit in accordance with the mains safety warning printed in this article.



### Important Safety Note

It is important to note that mains voltage is potentially lethal. Full details of mains wiring connections are shown in this article, and every possible precaution must be taken to avoid the risk of electric shock during maintenance and use of the final unit, which should never be operated with the box lid removed. Safe construction of the unit is entirely dependent on the skill of the constructor, and adherence to the instructions given in this article. If you are in any doubt as to the correct way to proceed, consult a suitably qualified engineer.

## PROJECT PARTS LIST

### RESISTORS: All 0.6W 5% Metal Film (Unless Stated)

R1-3	330Ω	3
R4	1k	1
R5-9	10k	5
R10	470k	1
R11	15k	1
R12,13	22k	2
R14	8k2	1
R15-17	470Ω	3
R18	820Ω	1
R19	47k	1
RV1-3	10k Vertical Preset Potentiometer	3
RV4	470k/500k Vertical Preset Potentiometer	1

### CAPACITORS

C1	680pF Ceramic Disc	1
C2	4n7F Ceramic Disc	1
C3	10nF Ceramic Disc	1
C4-6	100nF Resin-dipped Ceramic	3
C7	150nF Polyester	1
C8-12	1µF 50V Radial Electrolytic	5
C13-15	100µF 16V Radial Electrolytic	3
C16	1,000µF 25V Radial Electrolytic	1

### SEMICONDUCTORS

D1-4	1N400X	4
T1-3	BC547	3
VR1	78L08	1
LD1	5mm Red LED	1
TR1-3	Z0409/Q6004	3
IC1-3	K3020P	3
IC4	LM324	1

### MISCELLANEOUS

TRANSFO	9V 0.1A PCB-mounting Step-down Transformer	1
MIC	Electret Microphone Insert	1
F1	6-3A 20mm Time Delay Glass Fuse	1
F2	250mA 20mm Time Delay Glass Fuse	1
	20mm PCB-mounting Fuseholder with Cover	2
	6-pin DIL Holder	3
	14-pin DIL Holder	1
	2-pin Mains Socket	3
	PCB Pin	12
L1-3	Wire Links See Text	3
	PCB	1
	Box	1
	Knobs with Caps	4
	Self-Tapping Screws	8
	Shakeproof Washers	4
	Front Panel Label	1
	Instruction Leaflet	1 (XZ35Q)
	Constructors' Guide	1 (XH79L)

### OPTIONAL (Not in Kit)

	50µH/6A Toroidal Choke	3
	100nF 250VAC 500VDC Polyester	3

The Maplin 'Get-You-Working' Service is available for this project, see Constructors' Guide or current Maplin Catalogue for details.

**The above items are available in kit form only.  
Order As VF60Q (3-Channel Sound-to-Light Unit)**

Please Note: Some parts, which are specific to this project (e.g., PCB), are not available separately.

# MAPLIN

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